

Math 214: Linear Algebra

Spring 2020

Jay Daigle

Course Goals

In this course we will learn the basics of linear algebra, integrating three different perspectives. We will study the **geometry** of vectors and higher-dimensional spaces, the **algebra** of real vectors and matrices, and the **formal systems** of vector spaces and linear transformations. We will see how the three perspectives interrelate, and how each can be used to better understand the other two.

Mathematics is a fundamentally linguistic activity. In this course we will learn to speak and write the language of mathematics; understanding, writing, and communicating proofs will be a substantial portion of the course.

Topics will include: systems of linear equations; geometry and manipulation of vectors, lines, and planes; vector spaces and linear transformations; matrix arithmetic, inverses, and determinants; bases, spanning sets, and linear independence; and eigenvectors and eigenvalues.

Instructor Info

Lectures:	TR 1:30 - 3:00 PM	Fowler 201
Instructor:	Jay Daigle	Office Hours: MWF, 1:30 - 2:45 PM
Office:	Fowler 325	Often in Office: TR, 12:30 - 1:30 PM
Email:	gdaigle@oxy.edu	TR, 3:00 - 5:00 PM
Textbook:	NONE	Course Webpage: http://jaydaigle.net/linear

Learning Objectives

1. Determine whether an equation is linear; know when a system of linear equations has solutions, and find solutions using Gaussian elimination.
2. Manipulate vectors in \mathbb{R}^n and matrices algebraically; multiply matrices and find matrix inverses.
3. Prove facts about vector spaces and subspaces; determine whether a given subset is a subspace; and determine when sets of vectors are linearly independent, spanning sets, and/or bases.
4. Find the row, column, and nullspaces of matrices; identify linear transformations and find their kernels and images.
5. Use dot products and inner products to project one vector onto another, and use this to find orthogonal decompositions of vectors with respect to given subspaces.
6. Compute the determinant and trace of a matrix; determine whether a vector is an eigenvector of a given matrix; find the eigenvectors and eigenvalues of a matrix; use eigenvectors to diagonalize a matrix.

Course Description

Introduction to basic concepts of linear algebra through the study of linear algebraic systems and matrix algebra. Topics include: an introduction to planes and lines, vector operations, subspaces, Gaussian elimination, linear independence, invertibility of matrices, orthogonality matrix operations, eigenvalues, and eigenspaces. The course stresses definitions and mathematical proof.

Math 214 is a 4-unit course. It is expected that students in this class will be devoting at least twelve(12) hours a week (including in-class time) on average. Math 214 satisfies the Core Math/Science (CPMS) requirement.

References

There is no official textbook for this course, and you won't need to purchase any book for the course.

The primary reference I used to put together the notes *Linear Algebra with Applications*, ninth Edition, by Steven J. Leon.

If you would like more references or other perspectives, I have linked several on the course web page.

Grading

- Homework: 50%
- Midterms: 15% each
- Final: 20%

Course Policies

- **Exams:** There will be two midterms and a final. Tentative dates for the midterms are February 20 and March 31.

The final exam will be held according to the official schedule.

- **Homework:** Homework is in many ways the most important part of this class. Math is a skill, and, like all skills, requires practice to develop and learn. I encourage you to collaborate with classmates on your homework. However, you must turn in your own writeup in your own words.

I strongly encourage you to start the homework sets early. In addition to making them easier to finish on time, it's often easier to understand the material we cover if you go into the lectures with some specific questions; thus it's useful to at least read even the questions you're not prepared to start on yet.

Each homework assignment will have one or two "starred" problems. These are not necessarily the hardest problems, though they will rarely be the easiest. They are the problems which will benefit the most from starting early; some of them will require you to think deeply to come up with a new perspective, while some others may simply be quite long.

Homework is due in class on the due date, which will usually be Friday. Late homework will not be accepted except by prior arrangement or a note from Emmons or the deans. Please email me at least the night before the due date if you need to request an extension. (I often keep late hours; don't feel shy about emailing at two in the morning).

The homework assignment with the lowest score will not be counted. This includes homework which is not turned in, so missing one homework will not significantly affect your grade. However, it is still important to master that material on every homework assignment.

College Policies

- **Academic Ethics:** Students are expected to comply with the Student Handbook, in particular the section on Academic Ethics. You can find the policy at <https://www.oxy.edu/student-handbook/academic-ethics/academic-misconduct>
- **Title IX:** In the event that you choose to write or speak about having experienced sexual or interpersonal violence, including sexual assault, dating violence, domestic violence, stalking, sexual exploitation or any other form of sexual harassment, federal and state education laws require that, as your instructor and a designated Responsible Employee, I notify the Title IX office. They will contact you to let you know about accommodations and support services at Oxy and reporting options both on and off-campus.

If you do not want the Title IX Office notified, instead of disclosing this information to your instructor, you can speak confidentially with the following people on campus:

- Marianne Frapwell, Survivor Advocate, Project SAFE (survivoradvocate@oxy.edu)
- Emmons Counseling (For appointments, call: 323-259-2657)
- Rev. Dr. Susan Young, Office of Religious and Spiritual Life (young@oxy.edu)

The sexual misconduct policy, along with additional resources, can be found at: <http://www.oxy.edu/sexual-respect-title-ix/policies-procedures>.

- **Special Accommodations/Learning Differences:** Students with documented disabilities and learning differences who are registered with Disability Services are required to present their accommodation letter to the instructor at the beginning of each semester or as soon as possible thereafter. Any student who has, or thinks they may have, a physical, learning, or psychological disability may contact Disability Services at (323) 259-2969 to learn about available services and support. More information is available at <http://www.oxy.edu/disability-services>.
- **Accommodations for Reasons of Faith and Conscience:** Consistent with Occidental College's commitment to creating an academic community that is respectful of and welcoming to persons of differing backgrounds, we believe that students should be excused from class for reasons of faith and conscience without academic consequence. While it is not feasible to schedule coursework around all days of conviction for a class as a whole, faculty will honor requests from individual students to reschedule coursework, to be absent from classes that conflict with the identified days. Information about this process is available on the ORSL website: <https://www.oxy.edu/office-religious-spiritual-life>.